

fishes has received special attention. Since 1888 upwards of 30,000 white fish—such as cod, turbot, plaice, &c.—have been individually examined. By this means the time and duration of the breeding season has been determined, and the important fact has been proved that on the east coast of Scotland, where the investigation was mainly carried on, the spawning-grounds of the valuable food-fishes (cod, haddock, plaice, turbot, &c.) generally lie outside the territorial limit—contrary to the belief formerly held—and that only forms of comparatively little value, such as the flounder, dabs, and gurnards, &c., spawn within the three-mile limit. The importance of these facts cannot be over-estimated. They bear directly both on the question of establishing a close-time and the measures proper to be taken for the regulation of fishing on the breeding-grounds. The trawlers, driven outside the inshore waters, generally take to the breeding-grounds, for there the hauls are most abundant. The significance of this fact, in connection with the falling off in the inshore fisheries, is becoming too grave to be longer overlooked. The growth of population has been followed by an increase in the demand for fresh fish, the extension of the means of distribution has ministered to this demand, and if the floor of the ocean is to be swept without public regulation, the ordinary fishing-grounds will prove inadequate to maintain the supply. The destruction of spawning fish is proving a serious evil. In Germany, where this matter has been carefully examined, it is now held to be more important to protect the spawning-banks, than to prevent the destruction of immature fish. Some of our fisheries are, in fact, in danger of being exhausted unless judicious regulations are rigidly enforced.

During the last three years experiments have been carried on to determine the migratory movements of fish, and nearly 3000 have been labelled and returned to the sea. A percentage of these has been recovered, and steps are now being taken to apply the same method on a large scale to the herring. The experiments are not sufficiently advanced to justify any final conclusion as regards all fish, but undoubtedly as regards many of them the facts already ascertained prove that until they reach a certain size they do not leave the territorial waters.

The means of increasing the diminishing fisheries for shell-fish have received careful attention. Surveys have been made of the more important mussel-beds on the east coast, the extensive clam-bed in the Firth of Forth, the cockle-beds at Barra, and a detailed examination of the great mussel-growing area in the Clyde is at present in progress. The French system of growing mussels on wattled bouchots has been tested side by side with the bed-system, and a series of experiments have been made on board the *Garland* to test the comparative efficiency of different natural baits, and of various artificial substitutes. A physical and biological investigation has also been made of a number of sea-lochs on the west coast, in order to ascertain their suitability for the growth and culture of oysters (the Scottish oyster having sunk to a very low point), and a special lobster pond has been constructed at Brodick, Arran, in which about 200,000 young lobsters were hatched last year.

The physical observations into the temperature and salinity of the sea have been carried on on board the *Garland* and the fishery cruisers, and at ten fixed stations daily—five on the east coast and five on the west. By the courtesy of the Northern Lighthouse Board, observations are allowed to be taken daily at the Bell Rock and Oxcar Lighthouses, the lightship at the North Carr, and also at the mouth of the Tay. Many thousands of observations are thus made every year, and several valuable reports have already been published.

From this brief summary of part of the work done, it will be seen that considerable progress has been made since 1883 in extending the knowledge of the habits and life-history of the food-fishes; and it is gratifying to learn that the results obtained by the Board have been gratefully acknowledged by high authorities, and found useful in other countries.

In recent years the attention of the authorities of various maritime States, especially those around the North Sea, but also in the Mediterranean and in America, has been forcibly called to the diminution of the fish-supply within the territorial seas and on much-frequented fishing banks off shore. The falling off in the supply of valuable flat fishes, such as turbot, sole, and plaice, from the North Sea, has led to various conferences of those engaged in the fishing industry. At the International Fishery Conference held in London in 1890, at which representatives were present from Germany, Denmark, Holland, France, Belgium and Spain, it was resolved that scientific investigations

should be carried on by each country, particularly into the capture and destruction of immature fish by the beam-trawl, prior to the assembling of an official International Conference to deal with the subject by international agreement; and at a conference of representatives of the fishing industry held in London last February resolutions were passed, that in view of the diminution of the valuable food-fishes, the hatching of sea-fish should be undertaken on a large scale, and measures adopted to prohibit the sale of immature flat fishes under a certain size. The decrease in the fish supply from the off-shore banks has not yet become so marked off the Scottish coast as is the case further south; but from the statistics given below as to the yearly increasing number of Scottish beam-trawlers; the flocking northwards of English vessels from their own depleted grounds; and the actual diminution in the quantity of flat fish landed there is reason to apprehend that in the course of very few years a similar result will be brought about here. As has been stated above, the Board are at present having erected at Dunbar, by means of the ordinary vote for scientific investigation, on a site granted by the War Office and the Council of the Burgh, a large hatchery for sea-fish, with the necessary tanks and pumping apparatus, which, when complete, will permit of several hundreds of millions of the food-fishes being hatched every season and planted on the fishing-grounds. It will therefore be possible for the first time in this country to adopt active measures to directly add to the fish supply, as has already been done in the United States, Norway, Canada, and Newfoundland.

NOTES.

AMONG the honours announced at the change of Ministry the Privy Councillorship conferred upon Prof. Huxley not only establishes a precedent, but affords an indication that the neglect of the claims of men of science, whether they be servants of the Crown or not, to the ordinary national distinctions is not likely to be so marked in the future as it has been in the past. Six years ago or thereabouts, Prof. Huxley was allowed to leave the public service without the slightest recognition of the value of the work he had done in many capacities during some forty years. No better way of making the so-called "honours" ridiculous can be found than in generally omitting to confer them upon persons of distinction—persons known to the nation as devoting their lives to the national welfare in some walk or other.

WE have learned with regret a rumour to the effect that the Admiralty has declined to render the assistance in carrying observers and instruments for which the Royal Society made application some time ago to further the observations of the total solar eclipse in Senegambia next April. If this be confirmed, the expedition will in all probability be abandoned. Such a state of things requires no comment of ours.

A MEETING of the Swiss Society of Natural History is announced to take place at Basle, from September 4 to 7, under the Presidency of Prof. Hagenbach-Bischoff, and the following communications have been arranged for:—"The Origin of Swiss Lakes," Prof. A. Heim, Zurich; "The Thermal Conditions of the Lake of Geneva," Prof. F. A. Forel, Morges; "The Biological Conditions of the East-African Steppe," Prof. C. Keller, Zurich; "The Metamorphosis of Alpine Rocks," Prof. C. Schmidt, Basle; "The Evolution of Human and Animal Physiognomy," Prof. W. His, Leipzig; "Studies on the Veddahs, the Aborigines of Ceylon," Dr. Fr. Sarasin, Berlin. A special invitation is given to foreign students to join the meeting.

ACCORDING to the *Times* a telegram has been received from Tromsø announcing that the *Manche* which left Leith on July 20, for Jan Mayen Island, in the Greenland Sea, reached its destination on the 27th. The island had not been visited for ten years. The vessel went round it and then proceeded to Spitzbergen, where it made important collections of reindeer, foxes, birds, and fossils in Ja Fiord and Bel Sound.

MR. RISELY GRIFFITHS, the Administrator of the Seychelles, visited the Island of Aldabra in May last. In a report to the Colonial Office communicated to Kew, he gives the following particulars respecting the gigantic land tortoises:—"The following morning I went on shore to visit Mr. Spurs' establishment, and observe some of the natural peculiarities of this extraordinarily-formed island, which, except here and there, appears to be one mass of very ancient coral, which has been washed for so many centuries by the sea that all the softer portions have been washed out, and the remainder is hard and ragged, and therefore is difficult to walk over. Curious to state, small trees, shrubs and vines flourish over it, and in these inextricable places, which are of vast extent, do the enormous land tortoises find a genial and apparently prolific existence. When Mr. Spurs first went to Aldabra he was of opinion there were very few of them left; but he now states that there cannot be less than one thousand in all the island. I made him repeat this statement more than once, as I was sceptical about so large a number; but he assured me that a few hundreds would not accurately describe their number."

THE Tuesday evening lectures at the Royal Victoria Hall, Waterloo Bridge Road, will be resumed in September, and on the evenings of September 6, 13, and 20, respectively, Prof. B. J. Malden will lecture on "The Wonders of the World," "A Holiday in Sweden and Denmark," and "Australia."

ACCORDING to the *North British Agriculturalist* the plague of voles from which farmers in the Border districts have for some time past suffered much inconvenience and loss, is, notwithstanding the strenuous efforts put forward for the abatement of the plague, on the increase. The grass lands are so thickly set with the nests of the voles that much difficulty is experienced in cutting them, and the vermin are now making their abode in the corn-fields, which are in consequence also being destroyed.

CÁNOVAS AND TRAYNOR, 3 Calle de Santa Catalin 2, Madrid invite subscriptions to a facsimile reproduction of the first geographical chart of America (1500), by Juan de la Cosa, Columbus's sailing-master in his first and second voyages. It will be printed in the original colours, from which black, by the way, is absent. The work will be published in three forms, one—the popular—at 12s., another in vellum at 20s., and the third in parchment at £20. The parchment edition will be hand coloured.

PROF. FLÜCKIGER has sent to the President of the Pharmaceutical Society, as representing the British subscribers to the Flückiger testimonial, a bronze replica of the medal which was presented to him, and expresses the hope that it will be accepted as a sign of his gratitude and a slight proof of his appreciation of the friendship and encouragement he has always met with in England.

WE extract from the *Bollettino Mensile*, of the Meteorological Observatory of Riposto, the following details respecting the recent eruptions of Mount Etna. The crater had shown extraordinary activity from the beginning of July, and on the night of the 8th-9th, a severe shock in all the surrounding region announced the probability of an approaching eruption. At 1.20 p.m. on the 9th the south slope of the mountain burst open, at about 5000 feet above the sea, forming at once several mouths emitting lava, stones, and incandescent masses, as well as enormous quantities of sand and black smoke. At times large blocks were hurled to a height of about 1300 feet. Several of the mouths united, and formed three craters in an almost direct line from north to south, from two of which the lava encircled Monte Nero like an enormous river, while the third emitted masses of stones and cinders. The eruption continued

with more or less intensity all the month, but showed signs of diminishing on the 31st. The lava devastated much fertile country, but fortunately its course was checked by the deposits of former eruptions; if this had not been the case several of the villages would have been in great danger. This eruption was noteworthy for the enormous quantities of smoke and sand emitted, and for the scarcity of seismic motions; the lava resembled physically that emitted in the eruptions of 1883 and 1886.

THE thirty-ninth Report of the Department of Science and Art of the Committee of Council on Education is now ready, as is also the Directory (revised to June 1892), with regulations for establishing and conducting science and art schools and classes.

MESSRS. GIBBONS, of Liverpool, have issued a small handbook respecting the Department of Engineering in connection with University College, Liverpool, which should prove of much service to intending students, who will find in it all the information they are likely to require with reference to fees, subjects, evening lectures and classes, scholarships, certificates, &c., &c.

THE twenty-fifth annual report of the Peabody Institute of the City of Baltimore has been issued, and seems in every respect highly satisfactory. Incandescent electric lamps and appliances have been placed in the large hall and reading-room during the year, accessions to the library have been numerous and valuable, and the lectures were attended by larger audiences than in the preceding year. Another encouraging item in the report is that there was an increase in the number of applications for books relating to science, amongst the subjects which appear to have grown in favour being anatomy, astronomy, chemistry, mathematics, medicine, and natural history.

THE annual announcement of Courses of Instruction in the Colleges at Berkeley, Cal., for the academic year 1892-93 has recently been issued.

THE Calendar of University College, Bristol, for the Session 1892-93, has just been issued.

THE second edition of Mr. W. F. Kirby's "Elementary Text-Book of Entomology" has been published within the last few days by Messrs. Swan Sonnenschein and Co. The author has not thought it necessary to make any extensive alterations in the text or plates, but the following additions have been made to the work:—An appendix, giving further particulars respecting many of the insects mentioned or figured, and a complete index.

IN the *Board of Trade Journal* for August are to be found articles on "Chemical Industry in Germany," the "Sicilian Sulphur Industry," and "Cinchona and Indigo Cultivation in India."

THE current number of the *Journal of the Society of Arts* is, in the main, devoted to the publication of Prof. George Forbes' first lecture on "Developments of Electrical Distribution."

THE June number of the *Agricultural Gazette of New South Wales* contains the continuation of two articles by Mr. P. Turner, on "The Grasses of Australia," and "New Commercial Crops for New South Wales," "Notes on Economic Plants," "The Sugar Cane Disease on the Richmond and Clarence Rivers," and many other items of interest.

THE *Korean Repository* for June, which has just come to hand, has an interesting article by Rev. D. L. Gifford on "Ancestral Worship as practised in Korea."

MESSRS. CROSBY LOCKWOOD AND SON announce for early publication a new work by Mr. J. E. Gore, entitled "The Visible Universe, Chapters on the Origin and Construction of the Heavens."

British Rainfall for 1891, compiled by Mr. G. J. Symons and Mr. H. T. Wallis, has been published, and in consequence of the exceptional character of the year of which it treats, is rather later in making its appearance than its predecessors have been. The Devonshire blizzard was the cause of much work, and praise is due to those observers who were brave and persevering enough to take their observations, notwithstanding the very exceptional difficulties by which they were confronted. One observer was barricaded with five feet of snow against every door, and another—a lady—finding that the wind had swept the grass clean all round the rain gauge and piled the snow more than five feet deep near the entrance gates to her house, wrote to enquire what she was to enter as the depth of the snow.

Symons's Monthly Meteorological Magazine for August contains a summary of the climate of the British Empire for the year 1891, compiled from sixteen representative stations. The highest shade temperature occurred at Melbourne, 103° in January. This is the first occasion since the publication of these interesting tables in 1884, that the temperature of Melbourne has exceeded both Adelaide and Calcutta. In connection with high temperature, attention is drawn to the record at Alice Springs in the centre of Australia, which shows an absolute shade maximum of 117° in December, and an average maximum of above 100° for the month. The extreme maximum in the sun 165°, and the lowest mean humidity 57 per cent, were recorded at Adelaide. Winnipeg, as usual, had the lowest shade temperature, -34°·5, in February, as well as the greatest total range 128°·1, and greatest mean daily range 22°·9. Ceylon recorded the highest mean temperature, 80°·7, and also the least range in the year, there being only 21°·3 between the maximum of the hottest day and the minimum of the coldest night. Malta usually has the smallest rainfall or the least cloud; this year, however, Adelaide had the least rainfall, 14 inches, and Bombay the least cloud, the average amount being 3·6. The greatest rainfall was at Colombo, Ceylon, 119 inches. It is unfortunate that both the West Indian returns have had to be omitted owing to incompleteness.

ABOUT the middle of last week the low pressure areas which advanced over this country from the south-westward caused a rapid rise of temperature in England, the maximum shade temperatures reaching 83° in the south and east. These conditions were accompanied by violent thunderstorms over the southern, midland, and eastern counties on Thursday and Friday, the area embraced by the storm extending from Devonshire in the west to Norfolk in the north-east, while the rainfall was very heavy, amounting to 1·4 inch in several parts. During the early part of the present week the temperature continued high over the greater part of England, being about 10° above the mean for the time of year, but was much lower in Scotland and Ireland. Conditions were again unsettled on the 23rd, and about 1·5 inch of rain was measured in the south-west of Ireland on that morning, while areas of low pressure lay over our south-west coasts, and severe thunderstorms occurred in the evening over all the southern half of England. The heat on the Continent has been excessive, the thermometer in the shade registering 100° and upwards at many stations, and even reaching 108° at Biarritz and Bilbao. During the last few days, however, the weather has become somewhat cooler over Europe, although very high temperatures were still maintained. During the week ended the 20th inst. the rainfall exceeded the mean in Ireland and Scotland, but in most of the English districts there was a considerable deficit (except in the south and east, where there was an excess, owing to the thunderstorms). There still exists a deficiency in all districts from the beginning of the year amounting to 5 inches in the south and to 8·6 inches in the south-west of England.

THE firm of P. J. Kipp and Sons, Delft, have constructed a new form of their electro-dynamometer for the measurement of telephonic currents, in which several improvements have been introduced. As in the old form, in accordance with the suggestion of M. Bellati (*Atti del R.I. Ven.* 1883), a cylinder of soft iron wires takes the place of the usual movable bobbin. The cylinder becomes magnetized under the action of the current in the fixed coil; its magnetization being proportional to the strength of the current when sufficiently weak, and becoming reversed on the reversal of the current. The instrument is therefore eminently suitable for the measurement of weak alternating currents. The coil is wound in two parts, which may be used in series or in multiple arc, the resistance of each being about 250 ohms. A damping arrangement, similar to that employed in Thomson's quadrant electrometer, can be used. When the vibrations are not damped, speaking in a low voice into a Siemens telephone in connection with this instrument produces a deflection of 180mm. on a scale placed at the proper distance from a mirror which is attached to the iron cylinder. If one speaks at the distance of three or four metres from a microphone placed in the primary circuit of a small induction coil—the electro-dynamometer being in the secondary circuit—a deflection of 48mm. is obtained. The price of the instrument is 225 or 240 francs, according as a concave, or a plane, mirror is supplied. A guard ring of soft iron can be supplied for twenty-two francs additional. The firm believe that the instrument will be of great use to physiologists. It is largely used in continental laboratories.

REPORTING lately to the Société d'Encouragement on the industrial preparation of carbonic acid in France, commenced by M. Gall, M. Troost points out that in Germany, which preceded France in this matter, what greatly stimulated the work was the consumption of beer, as it was found that by pressure of carbonic acid on beer, the latter could be brought up from cellars to bars in excellent condition, while compressed air spoiled the beer. In France, on the other hand, success has been due to the large quantities of salicylic acid used in medical treatment, this substance being largely produced by the reaction of liquid carbonic acid on sodium-phenol. The *Compagnie générale des produits antiseptiques* has works near Hermes (Oise), directed by M. Gall. Pure carbonic acid is there produced very economically by combustion of coke; is collected in a gasometer, from which it is drawn, to be dried and compressed with pressures of 5, 25, and 70 atmospheres, and stored in iron bottles. Most of the acid is used for making salicylic acid; but other applications occur, and M. Gall is increasing the power of manufacture. At present 300 kilogrammes are produced daily, but it will be possible ere long to produce 1000 kilogrammes. The liquid is now supplied in Paris at 60 c. the kilogramme (say 6d. for 2½ lbs.). Thus the French production is in a condition to compete with the German. Among other uses besides those already mentioned are the manufacture of aerated waters, the filtering of wine, cooling by virtue of the great absorption of heat in vaporizing, and solidification of fused metals under high pressure (which greatly improves the quality).

FROM a recent report on the telephone system in Belgium (which has grown rapidly since 1883) we learn that the State has considerably supplemented the work of the companies constructing and working various small lines, and using on all of them the double wire (while the companies have mainly continued the single one). The material used is the phosphorus bronze of Montefiore. The subscription varies largely, from 250 fr. in a radius of 3 km. in Brussels and Antwerp, to 125 fr. in Louvain and Malines. One interesting feature of the Belgium lines is that they are all connected with the principal telegraph offices, so that subscribers can send to these, by telephone, any telegrams they wish sent, and similarly they can receive tele-

phonically any telegrams addressed to them. A copy of the telegram is sent at the same time. The number of telegrams thus sent by telephone in 1889 was 371,000; in 1890 it grew to 440,000. To facilitate the development of telephonic relations the country is divided by Government into a number of circles, containing several towns provided with central offices communicating with each other by means of a double wire. Thus the inhabitants of a small town like Heyst are able to speak with Bruges, Blankenburgh, Ostend, Middlekerke, and Nieuport. The system is being extended wherever clients are probable, and the telephone now enters largely into Belgian habits.

IN the south-east of the valley of Mont Dore (Puy-de-Dôme) is a curious natural formation in the basalt, called the Creux-de-Souci. A crater-shaped depression about 80 ft. wide communicates by a central hole with a larger circular cavern, 170 ft. diameter, the bottom of which is occupied by a small lake with about 10 ft. of water. The shape is like that of two cups with bases opposed; the lower one the larger. From an examination of the place this summer by M. Martel and some friends (*La Nature*), it appears that carbonic acid is plentiful in the cavern. Several times they went down by rope-ladder, hoping to use a boat lowered previously; but they could not get below about 13 ft. from the water (which was about 70 ft. from the orifice); they experienced headache, progressive suffocation, &c., while matches and candles went out. The cavern is probably closed; there is no sign of a stream; nor are there any stalactites. The lake is merely fed by water filtering through the basalt; after heavy rain this is considerable. The temperature is exceptionally low, which M. Martel explains thus: Snow lies several months on the neighbouring ground, and when this melts in spring its water penetrates into the Creux-de-Souci at a temperature near 0°C. Thus the air is cooled, and, being denser than that outside it, accumulates below; it is not renewed from above. No air-current was observed. The accepted view that there is water communication with Lake Pavin (about 270 ft. lower) is considered a mistake. It would be interesting, M. Martel says, to make methodical observations, in different seasons, both as to the carbonic acid and the temperature.

MR. C. DAVIES SHERBORN asks us to state that the grant from the British Association, stated by us as being made towards "Index to Plants," &c., was really towards "Index Generum et Specierum Animalium," a work which has already been referred to on two occasions in *NATURE*—May 15, 1890, and July 2, 1891.

THE additions to the Zoological Society's Gardens during the past week include a Japanese Ape (*Macacus speciosus*, ♂) from Japan, presented by Mr. H. H. Jacobs; two Rhesus Monkeys (*Macacus rhesus*, ♂ & ♀) from India, presented by Mr. R. Dodman and Mr. C. W. Emlin respectively; a Macaque Monkey (*Macacus cynomolgus*, ♀) from India, presented by Mr. R. Rocca; two Crowned Lemurs (*Lemur coronatus*) from Madagascar, purchased; a Common Cormorant (*Phalacrocorax carbo*), British, presented by Capt. Salvin; two Spotted-sided Finches (*Amadina lathami*) from Australia, purchased; twenty-five Cambayan Turtle Doves (*Turtur senegalensis*) from East Africa, deposited by General Mathews; three Cambayan Turtle Doves (*Turtur senegalensis*) from East Africa, presented by General Mathews; three Hardwick's Mastigures (*Uromastix hardwicki*) from India, purchased; a Robben Island Snake (*Coronella phocaenum*) from South Africa, presented by Miss M. Rutherford; a Nilotic Monitor (*Varanus niloticus*) from East Africa, presented by Gen. Mathews; a Nilotic Monitor (*Varanus niloticus*) from East Africa, presented by Mr. Frank Finn, F.Z.S.; two Smooth-clawed Frogs (*Xenopus eavis*) from East

Africa, presented by Mr. Frank Finn, F.Z.S.; a Common Boa (*Boa constrictor*) from South America, presented by Messrs. F. Sander and Co.; four Indian Wild Swine (*Sus cristatus*), born in the menagerie.

OUR ASTRONOMICAL COLUMN.

NOVA AURIGÆ.—In *Wolsingham Observatory Circular*, No. 33, it is stated that Mr. H. Corder having informed the Rev. T. E. Espin that the Nova Aurigæ had increased, it was examined August 21, and found to be 9.2, spectrum monochromatic; one intense line (500?).

THE OPPOSITION OF MARS.—At the Lick Observatory, up to the middle of August, many of the supposed canals on Mars discovered in 1877 by Schiaparelli were mapped, but none of them seemed to be double. On the night of the 17th inst., however, Profs. Schaberle, Campbell, and Hussey made three entirely independent drawings, each showing the canal marked Ganges on Schiaparelli's map to be distinctly double, and thus confirming in 1892 Schiaparelli's discovery of 1877.

THERMAL ABSORPTION IN THE SOLAR ATMOSPHERE.—In *Astronomische Nachrichten*, Nos. 3105-06, Mr. E. B. Frost sets forth the results of his observations with reference to thermal absorption in the solar atmosphere. As the paper is of considerable length, we will only concern ourselves with the broad results, leaving our readers to look up the details for themselves. The instrument—made by Mr. Frost himself, and used throughout the experiments—was a double thermopile, or, rather, two thermopiles, of considerable length; and the back junctions, after being carefully insulated and imbedded in sealing-wax, were inserted in the two ends of a brass U-shaped tube, the front faces of the piles projecting a little out of the tube, while their back parts were in contact in the middle. To ensure an equality of temperature at the two back junctions, this part of the tube was enveloped in a cylinder filled with water, thus eliminating practically accidental thermo effects in the metals of the thermopiles. Mr. Frost's original intention was to employ both these piles, one for receiving the projected image of the sun, and the other for the direct rays, but, as he became acquainted with the "disproportionately greater intensity of the latter," he was obliged to employ as a screen a thin silk gauze, thus using this pile as a counterpoise to eliminate such effects as air currents, reflected radiations, &c.

Let us deal first with the photosphere. The following table shows the differences between observation and theory. The column headed O is obtained from a curve based on the observations, that of C is the result of theory and gives the values of $I : I_0$ as obtained from the ratio $\frac{1}{I_0} = \frac{e^{-f \sec \theta}}{e^{-f}}$. ρ represents the distance of the point observed from the centre of the sun (radius = 100), and θ the angle at the sun's centre between the line to the observer and the radius to the point observed.

ρ	θ	O	C	C-O
0	0	100.0	100.0	0.0
10	5.7	99.9	99.8	-0.1
20	11.5	99.4	99.3	-0.1
30	17.5	98.4	98.4	0.0
40	23.6	96.3	97.1	+0.8
50	30.0	93.6	95.1	+1.5
60	36.9	89.8	92.2	+2.4
70	44.4	84.6	87.8	+3.2
80	53.1	77.9	80.6	+2.5
90	64.2	68.0	65.6	-2.4
100	90.0	(39)	—	—

The differences in the last column might, as Mr. Frost says, be somewhat reduced by the introduction of another constant in the formula, but even then sufficient difference would remain to indicate the inability of the formula to cope with the present conditions.

In the attempt to ascertain whether there was a difference in the thermal conditions for the poles and the equator, taking points equidistant from the centre of the sun's disc, the conclusion Mr. Frost draws is that there is none. The difference between the two hemispheres also he finds "to be exceeding small, if real." With regard to the spots he says, "A rather surprising result of these observations was that spots are occasionally relatively warmer than the surrounding photosphere." Whether the position of the spot on the disc had anything to do with it is